

While our conclusions are based on the study of only 200 patients, we believe that these results merit publication at this stage because of their implication. This study will continue until at least 200 patients have been studied in each group.

We are extremely grateful to the staff surgeons and patients who co-operated so wholeheartedly in this study. Expert technical help was provided by Mrs T Wolfe, Mrs G M Wheeler, and Mrs G Shaw. Financial help obtained from the South African Medical Research Council, the University of Cape Town Staff Research Fund, the Nellie Atkinson Trust, and Noristan Laboratories is gratefully acknowledged.

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Vaginal microbial flora in normal young women

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Summary and conclusions

Vaginal swabs were taken from 1498 women attending a family planning clinic. The flora was assessed in the absence of any information about the women to whom the swabs related. Yeasts and fungi were present in 311 women (21%) and were no more prevalent among "pill" users than others. *Candida albicans* was significantly associated with vulval itching and with a vaginal discharge described as heavier than normal or curdy on clinical examination, though these abnormalities were present in only a minority of women with the organism. *Trichomonas vaginalis* was found in 14 women (1%) and was associated with abnormalities of vaginal discharge in all but one. Gram-negative anaerobic bacilli were significantly more common in women with a troublesome vaginal discharge and those who used an intrauterine device than others. No associations were found between fungi other than *C. albicans* or the other bacteria sought and either symptoms or clinical abnormalities of vaginal discharge.

Introduction

Information about the normal vaginal flora is needed when assessing the pathogenic role of organisms in women with genito-

urinary symptoms. The vaginal flora has often been studied in selected patients—for example, in women with vaginal discomfort or discharge,¹⁻³ in women attending venereology clinics,^{4,5} in patients before gynaecological operations,^{6,7} and in pregnant women.^{8,9} Studies on normal women have, however, been fewer and usually based on small numbers.¹⁰⁻¹² We have therefore studied the vaginal flora in 1498 women, who were unselected except that they sought contraceptive advice from a family planning clinic.

Patients and methods

The study was conducted at the Edinburgh Family Planning Centre between October 1975 and March 1977. Women were included if they were either new patients or repeat attenders who had not been seen at the clinic for at least six months. The clinical methods (including questions used to elicit symptoms) are described elsewhere.¹³ In brief, characteristics of the women (including symptoms if any) were recorded by a research nurse using a structured questionnaire. Each woman was then examined by a doctor who, to avoid bias, was not provided with any medical history. Findings on vaginal examination were recorded on a structured check list. Albumin-coated swabs (Exogen) were taken from the external cervical os of all women, from the vaginal fornix of all women in whom the vaginal discharge was considered to be abnormal in either quantity or consistency, and from the fornix of a sample of 145 women with no abnormal vaginal discharge. Duplicate swabs were taken from each site under direct vision through a speculum. Care was taken to minimise the possibility of contaminating a swab from one site with material from another.

For each specimen one of the duplicate swabs was broken off into Stuart's transport medium (Oxoid). The other was streaked over one-third of the surface of a plate of Phillips selective medium and then broken off into trichomonas medium (Oxoid). Specimens were kept at room temperature until arrival at the laboratory, where they were used to inoculate, respectively, plates of blood agar, MacConkey's medium and neomycin blood agar (from the transport medium), and malt-peptone agar (from the trichomonas medium). The neomycin blood agar plate and one blood agar plate were incubated anaerobically in 90% hydrogen plus 10% carbon dioxide. The other blood agar plate and the plate of MacConkey's medium were incubated aerobically.

The flora was assessed in the absence of any information about the women to whom the swabs related. Full details of culture media, isolation procedures, and definitions used are available on request (to MJG) and will be given elsewhere. Only the predominant colony types were noted: very small numbers of other types of colony (except those on Phillips selective medium for *Neisseria gonorrhoeae*) were ignored.

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TABLE I—Prevalence of organisms cultured from cervical os and vaginal fornix in presence and absence of clinically abnormal vaginal discharge. Results expressed as numbers and percentages of women

Organisms	Normal vaginal discharge						Abnormal vaginal discharge			
	Os (n = 660)		Os (n = 145)*		Fornix (n = 145)*		Os (n = 693)		Fornix (n = 693)	
	No	%	No	%	No	%	No	%	No	%
<i>Candida albicans</i>	75	11.4	16	11.0	17	11.7	110	15.9†	122	17.6
Other fungi	44	6.7	8	5.5	9	6.2	27	3.9	36	5.2
Anaerobes	94	14.2	15	10.3	17	11.7	128	18.5‡	146	21.1
Coliforms	95	14.4	24	16.6	28	19.3	94	13.6	112	16.2
β -Haemolytic streptococci ..	35	5.3	2	1.4	3	2.1	22	3.2	22	3.2
<i>Neisseria gonorrhoeae</i>	1	0.2	0		0		1	0.1	1	0.1
<i>Trichomonas vaginalis</i>	1	0.2	0		0		7	1.0§	13	1.9

*Sample of women with no abnormal vaginal discharge from whom swabs were taken from both os and fornix (see text).

Significance of difference in prevalence of organisms isolated from os between 693 women with abnormal discharge and 805 women without: † $\chi^2_1 = 6.3$, $P < 0.05$; ‡ $\chi^2_1 = 6.4$, $P < 0.05$; § $P < 0.05$ (Fisher's exact test).

TABLE II—Prevalence of fungi in different age groups. Results expressed as numbers and percentages of women

Age group (years)	No of women	Organisms			
		<i>Candida albicans</i>		Other fungi	
		No	%	No	%
16-24	710	131	18.5	40	5.6
25-34	465	55	11.8	17	3.7
35-47	323	39	12.1	29	9.0
Total	1498	225	15.0*	86	5.7†

Significance of difference in prevalence between age groups: * $\chi^2_1 = 12.5$, $P < 0.01$; † $\chi^2_1 = 10.0$, $P < 0.01$.

Organisms were divided into the following groups: *Candida albicans*—namely, yeast isolates that produced a "germ tube"¹⁴ (this would include *C. stellatoidea*, which, however, represents only a small proportion of the group in our experience); other fungi—namely, germ-tube-negative yeasts, identified by the principles and methods of Lodder¹⁵; anaerobes, comprising both obligately anaerobic, metronidazole-sensitive, non-sporing Gram-negative anaerobic bacilli and anaerobic cocci as defined by Watt and Jack¹⁶; coliforms—namely, Gram-negative bacilli capable of growth on MacConkey's medium; and β -haemolytic streptococci—namely, catalase-negative Gram-positive cocci showing beta-haemolysis on horse-blood agar.

We also identified enterococci, *Haemophilus* spp (though not *Corynebacterium vaginale* separately), Gram-positive cocci, and Gram-negative bacilli but found little of interest and do not consider these organisms in detail here. We did not examine specimens for *Chlamydia* spp, viruses, or T-strain mycoplasmas.

Results

PREVALENCE OF ORGANISMS

With the paired swabs organisms were isolated a little more commonly from the vaginal fornix than from the external os both in women with a clinically abnormal vaginal discharge and in women without. *C. albicans*, anaerobes, and *Trichomonas vaginalis* were also found significantly more often in women with an abnormal discharge than in those without ($P < 0.05$ —table I).

C. albicans was cultured from a total of 225 (15.0%) of the 1498 women, other fungi from 86 (6.0%), anaerobes from 262 (17.0%), coliforms from 244 (16.0%), and β -haemolytic streptococci (β -HS) from 63 (4.0%). *T. vaginalis* was isolated from 14 women (1.0%) and was associated with

a clinically abnormal discharge in all but one. *N. gonorrhoeae* was isolated from two women, both of whom were asymptomatic: one had a clinically normal vaginal discharge and the other a mucopurulent discharge.

We studied the associations described below separately for isolates from the os and fornix and from both sites together. The results were closely similar and, for simplicity, are presented for women from whom each group of organisms was cultured either from the os or from the fornix or from both.

C. albicans was significantly more prevalent in women aged under 25 than in older women (table II). Other fungi were significantly commoner in women aged 35 and over than in younger women. There were no significant associations between age and the isolation of other organisms. The isolation rate of fungi showed a modest variation with different quarters of the year—namely, 20.8%, 23.7%, 23.2%, and 18.3%, in the successive quarters respectively.

ASSOCIATIONS WITH CONTRACEPTIVE METHODS

The prevalence of *C. albicans* was similar in women using different methods of contraception (table III). In particular, *C. albicans* was no commoner in women using the "pill" than in others. The apparent association between other fungi and contraceptive methods disappeared when account was taken of age—for example, other fungi were more common and use of the pill less common in older women. Anaerobes were isolated from 33% of women who used an intrauterine device (IUD) compared with 16% of women who did not. β -HS were also slightly more common in women who used an IUD than in others ($\chi^2_1 = 3.6$; $P = 0.07$). These higher isolation rates among IUD users than others were mainly due, respectively, to Gram-negative anaerobic bacilli (GNAB) and group-B strains of β -HS.

ASSOCIATIONS WITH SYMPTOMS AND SIGNS

Vulval itching was significantly more common in women with *C. albicans* than in those without ($P < 0.001$ —table IV). The prevalence of itch in women with *C. albicans* was similar whether or not they used the pill. There were no other significant associations between *C. albicans* and symptoms, though 10 (4.4%) of the 225 women with *C. albicans* had dysuria compared with 21 (1.8%) of the 1187 women from whom fungi were not cultured. Although the symptom of troublesome vaginal discharge was no commoner in women with *C. albicans* than others, an abnormal vaginal discharge on clinical examination was significantly more common in women with this organism (see table I). The amount of discharge on examination was

TABLE III—Prevalence of organisms in women using different methods of contraception. Results expressed as numbers and percentages of women

Method	No of women	Organisms									
		<i>Candida albicans</i>		Other fungi		Anaerobes		Coliforms		β -Haemolytic streptococci	
		No	%	No	%	No	%	No	%	No	%
None	378	56	14.8	32	8.5	57	15.1	54	14.3	18	4.8
Pill	546	81	14.8	21	3.8	80	14.7	82	15.0	17	3.1
IUD	146	23	15.8	7	4.8	48	32.9	24	16.4	11	7.5
Barrier	428	65	15.2	26	6.1	77	18.0	84	19.6	17	4.0
Total	1498	225	15.0	86	5.7*	262	17.5†	244	16.3	63	4.2

Significance of difference in prevalence between women using different contraceptive methods: * $\chi^2_3 = 9.1$, $P < 0.05$; † $\chi^2_3 = 28.6$, $P < 0.001$.

TABLE IV—Prevalence of symptoms in women with each group of organisms. Results expressed as numbers and percentages of women

Symptom	Organisms													
	<i>Candida albicans</i> (n = 225)		Other fungi (n = 86)		Anaerobes (n = 262)		Coliforms (n = 244)		β -Haemolytic streptococci (n = 63)		<i>Trichomonas vaginalis</i> (n = 14)		All women (n = 1498)	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Troublesome vaginal discharge ..	34	15.1	10	11.6	66	25.2†	33	13.5	10	15.9	7	50.0¶	259	17.3
Vulval itch ..	54	24.0*	3	3.5	33	12.6	26	10.7	10	15.9	3	21.4	136	9.1
Backache ..	39	17.3	21	24.4	52	19.8‡	31	12.7	11	17.5	3	21.4	234	15.6
Frequency of micturition ..	32	14.2	8	9.3	30	11.5	28	11.5	12	19.0	3	21.4	198	13.2
Nocturia ..	29	12.9	10	11.6	29	11.1	38	15.6	8	12.7	2	14.3	186	12.4
Dysuria ..	10	4.4	1	1.2	7	2.7	7	2.9	0	0	0	0	32	2.1
Postcoital spotting ..	10	4.4	5	5.8	27	10.3§	15	6.1	4	6.3	1	7.1	76	5.1
Dyspareunia ..	6	2.7	3	3.5	13	5.0	10	4.1	4	6.3	2	14.3	58	3.9

Significance of difference in prevalence between women with and without each organism: * $\chi^2=64.7$, $P<0.001$; † $\chi^2=13.2$, $P<0.001$; ‡ $\chi^2=3.9$, $P<0.05$; § $\chi^2=16.7$, $P<0.001$; ¶ $\chi^2=8.4$, $P<0.01$.

described as "considerably more than normal" in 125 women. *C. albicans* was isolated from 28 (22%) of these women compared with 197 (14%) of the 1373 women whose discharge was not so described ($\chi^2=5.2$; $P<0.05$). The consistency of discharge on examination was described as "curdy" in 101 women. *C. albicans* was isolated from 29 of these women compared with 196 (14%) of the 1397 women whose discharge was not so described ($\chi^2=14.8$; $P<0.01$).

There was no association between the isolation rate of other fungi and symptoms or the clinical description of vaginal discharge. The suggestive association between other fungi and backache (both of which were more common in older women) no longer held when account was taken of age.

Vaginal discharge was reported significantly more often by women with *T. vaginalis* infection than without ($\chi^2=8.4$; $P<0.01$). Too few women had this organism to permit conclusions to be drawn about other possible associations.

Troublesome vaginal discharge, backache, and postcoital blood spotting were reported significantly more often by women from whom anaerobes, especially GNAB, were cultured (table IV). Thus GNAB were associated both with the use of an IUD and with symptoms. We therefore compared the prevalence of symptoms in women with and without GNAB according to whether they used an IUD. Table V shows that troublesome vaginal discharge, backache, and postcoital spotting were all substantially commoner in women who used an IUD than in others (whether or not GNAB were present). Within both the

found no association between use of the pill and the isolation of either *C. albicans* or other fungi. Possibly some of the women in our study had stopped taking the pill because of troublesome candida infections in the past. A history was taken of each woman's past symptoms and their treatment, however, and there was no obvious evidence to support this. The possibility remains, which we cannot refute, that the pill enables *C. albicans* to assume a pathogenic role in a small proportion of women; but our data suggest that in the great majority of women it does not.

There was a significant association between the isolation of *C. albicans* and vulval itch. No other statistically significant association between *C. albicans* and symptoms was found, though dysuria was slightly more common in women with this organism than in others. Although we found no association between *C. albicans* and troublesome vaginal discharge, *C. albicans* was significantly more common in women whose vaginal discharge was reported as greater than normal in quantity or curdy by the clinic doctors.

The abnormalities described above were found in only a minority of the women with *C. albicans*. We suggest that the mere isolation of fungi, including *C. albicans*, from the vagina is not itself indicative that the organism has assumed a pathogenic role or that treatment is required. Nevertheless, when features such as heavy discharge, curdy discharge, or vulval itch are present the isolation of *C. albicans* may be clinically important. No significant association between other fungi and clinical symptoms or signs referable to the lower genital tract was found in this study.

T VAGINALIS

Abnormal vaginal discharge was appreciably more prevalent in women with *T. vaginalis* infection than without, and the pathogenic role of this organism is undoubted. *T. vaginalis* was isolated from only 14 (1%) of the women in this study. In a further study²⁰ every cervical smear report returned to the clinic during 1978 was scrutinised: the reported prevalence of *T. vaginalis* was similarly low at 1.2% (37 of 3036 women).

BACTERIA

The association between the isolation of anaerobes and the use of an IUD is interesting because both have been implicated in the aetiology of pelvic inflammatory disease.²¹⁻²³ In our study both GNAB and the use of an IUD were associated with a history of troublesome vaginal discharge and postcoital spotting. These symptoms were substantially more common in women who used an IUD than others whether or not GNAB were present; and there was also a strong suggestion (table V) that GNAB are associated with these symptoms in both users and non-users of IUDs. We cannot tell whether the association between GNAB and these symptoms is causal: possibly GNAB are secondarily associated with some additional factor, not identified by us, itself causally related to symptoms. For example, specimens were not examined for *Chlamydia* spp or viruses; in some patients the anaerobic organisms might conceivably represent superinfection of underlying chlamydial or viral

TABLE V—Prevalence of symptoms in presence and absence of Gram-negative anaerobic bacilli in IUD users and others. Results expressed as numbers and percentages of women

Symptoms	IUD users				Others			
	Bacilli present (n = 39)		Bacilli not present (n = 107)		Bacilli present (n = 142)		Bacilli not present (n = 1210)	
	No	%	No	%	No	%	No	%
Vaginal discharge ..	17	43.6	31	29.0	36	25.4	175	14.5
Backache ..	12	30.8	29	27.1	23	16.2	170	14.0
Postcoital spotting ..	11	28.2	17	15.9	10	7.0	38	3.1

IUD-user and non-user groups troublesome vaginal discharge and postcoital spotting were more common in women with GNAB than without, but the prevalence of backache was similar in the presence and absence of GNAB.

There was no significant association between the other groups of bacteria sought and genital symptoms. There was no association between the isolation of any particular group of organisms and the presence (as reported by the women) of genital symptoms in the partner.

Discussion

YEASTS AND FUNGI

Fungi are commonly found in the vaginal flora of young women and were isolated from 311 (21%) of the women in this study. The relation between vaginal candidiasis and use of the contraceptive pill has been controversial. An association has been suggested by some workers^{17, 18} but not by others.^{5, 19} We

infections. The association between genitourinary symptoms and vaginal anaerobic infection warrants further study. Meanwhile there is little to indicate that, with the possible exception of *Corynebacterium vaginale*,^{24 25} other bacteria have any pathogenic role in the vagina of the great majority of young women.

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Details of culture media, isolation procedures, and definitions used may be obtained from: Dr M J Goldacre, Department of Social Medicine, University of Oxford, 8 Keble Road, Oxford OX1 3QN.

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Vagotomy and pyloric dilatation in chronic duodenal ulceration

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A total of 101 patients suffering from duodenal ulcer underwent truncal vagotomy (TV) combined with pyloric dilatation (PD). They were followed up over six years, and the results were found to compare favourably with those in patients who underwent alternative surgical measures. Before any revisionary surgery 79 patients were classified as Visick grades I plus II. The incidence of recurrent ulceration was 4%. Side effects were noticeably less common than in patients in whom a drainage procedure had been performed, and overall results were compared with those reported for groups of patients treated by proximal gastric vagotomy.

The combination of TV and PD is commended on account of its simplicity, safety, and effectiveness at a time when medical treatment for duodenal ulcer is becoming more specific and increasingly effective.

Introduction

Although the advent of H₂-receptor antagonists has to some extent altered the attitude of many clinicians to the management of

duodenal ulceration, such advances in medical treatment have emphasised the need for a safe, simple, and effective elective surgical alternative should conservative management fail. Since Dragstedt¹ established truncal vagotomy (TV) as an acceptable method of treatment workers have realised that an appreciable number of patients do not require a concomitant drainage procedure to overcome problems related to gastric stasis, and that such additional procedures as gastroenterostomy or pyloroplasty may give rise to certain undesirable sequelae.² More recently interest has centred on establishing a technique whereby the stomach can be adequately vagotomised without giving rise to difficulties associated with gastric emptying. This work culminated in the introduction into clinical practice of the concept of proximal gastric vagotomy (PGV) in 1969 by Johnston and Wilkinson.³

A vast amount of work, both clinical and experimental, has been done on the physiological effects of vagal section.⁴ In so far as gastric motility is concerned most workers seem generally to agree that any stasis that results from vagotomy is most probably variable in degree and temporary in nature.⁵ There would seem, therefore, to be little logic in rendering the stomach permanently incontinent as a matter of routine by performing either of the usual drainage procedures in order to overcome an essentially transient problem. The function of the gastric antrum and pylorus should be retained whenever possible. In cases in which the gastric outlet is found at laparotomy not to be unduly scarred or fibrosed we have overcome the transient problems of postvagotomy stasis by gradually stretching the smooth-muscle fibres of the pyloric canal and thus facilitating gastric emptying. We here report the results of TV and pyloric

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